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Three species of *Linkosia* and *Spadicoides* new to China

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Abstract—Specimens of *Linkosia longirostrata*, *Spadicoides klotzschii*, and *S. sylvatica* were collected on dead branches of unidentified plants and identified as new records from China. They are described and illustrated based on the Chinese material. Keys are also provided to *Linkosia* and *Spadicoides* species recorded from China.

Key words—asexual morph, hyphomycetes, taxonomy

Introduction

Linkosia A. Hern.-Gut. & B. Sutton, established in 1997 with *Sporidesmium coccothrinacis* A. Hern.-Gut. & J. Mena [≡ *L. coccothrinacis* (A. Hern.-Gut. & J. Mena) A. Hern.-Gut. & B. Sutton] as type species, is mainly characterized by conidiophores that are reduced to monoblastic conidiogenous cells producing solitary, distoseptate conidia (Hernández-Gutiérrez & Sutton 1997, Wu & Zhuang 2005). After Zhang et al. (2009) provided a key to the then-known six species, six additional species were described by Ma et al. (2011), Almeida et al. (2014), Delgado (2014), and Conceição et al. (2016). Of the twelve species currently accepted in the genus (Conceição et al. 2016), five have been recorded from China (Wu & Zhuang 2005, Zhang et al. 2009, Ma et al. 2011).

Spadicoides S. Hughes, established in 1958 with *Helminthosporium binum* Corda [≡ *S. bina* (Corda) S. Hughes] as type species, is diagnosed by distinct, unbranched or sparingly branched conidiophores with integrated, polytretic, terminal or intercalary conidiogenous cells producing solitary, acropleurogenus, unicellular or euseptate conidia (Hughes 1958, Ellis 1971, Sinclair et al. 1985, Seifert et al. 2011). Forty-two species have been described, of which fifteen have been recorded from China (Zhou et al. 1999, Lu et al. 2000, Ho et al. 2002, Wong et al. 2002, Cai et al. 2004, Li et al. 2010, Ma et al. 2010, 2012, 2014, 2016, Xia et al. 2014). Goh & Hyde (1996) and Ma et al. (2016) have provided synoptic tables of relevant morphological characters of *Spadicoides* species.

During our continuing surveys of saprobic microfungi from the forests of southern China, we have collected specimens representing three new Chinese records of *Linkosia* and *Spadicoides* on dead branches. They are described and illustrated below. The specimens are conserved in the Herbarium of the Department of Plant Pathology, Jiangxi Agricultural University, Nanchang, China (HJAUP).

Linkosia longirostrata G. Delgado, Mycotaxon 129(1): 42, 2014. FIG. 1

CONIDIOPHORES absent or very reduced, erect, 1-septate, dark brown, 21–35 μm long, 6–12.5 μm wide at the swollen base. CONIDIOGENOUS CELLS monoblastic, integrated, terminal, lageniform or subcylindrical, smooth, brown to dark brown, determinate or occasionally percurrent, 15–27 × 5–6 μm, 3–4 μm wide at the truncate apex. CONIDIA holoblastic, solitary, acrogenous,

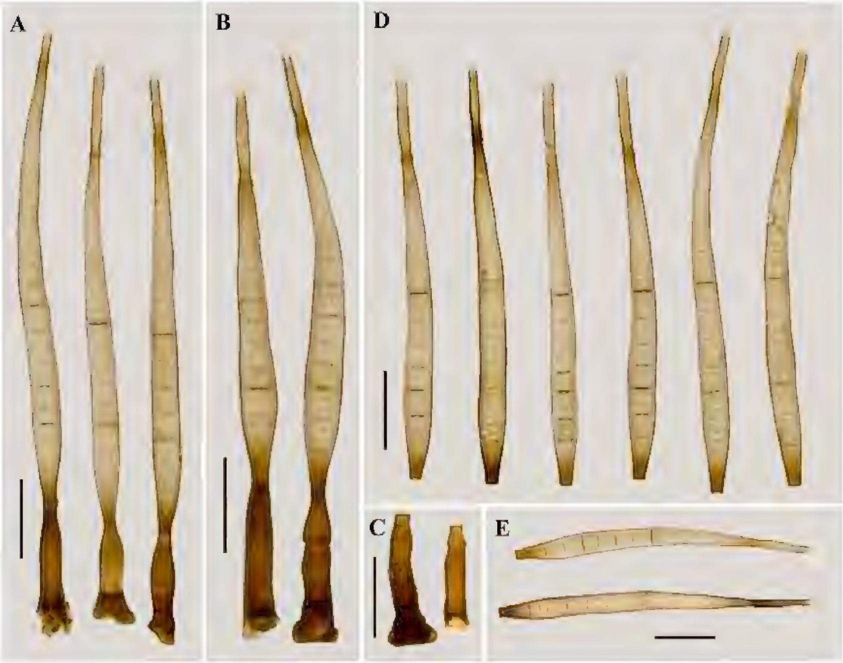

FIG. 1. *Linkosia longirostrata* (HJAUP M0162). A, B. Conidiophores, conidiogenous cells and conidia; C. Conidiophores and conidiogenous cells; D, E. Conidia. Scale bars = 20 μm.

straight or curved, obclavate to obclavate-rostrate, pale brown, smooth, 10–18-distoseptate, 82–126 µm long, 6.5–8.5 µm wide in the broadest part, 3–3.5 µm wide at the truncate base, apex extended into a pale brown to brown rostrum, 2–2.5 µm wide, and invested in 1–3 spherical or subspherical, hyaline or subhyaline mucous tunicae ca 6–15 µm diam.

SPECIMEN EXAMINED: CHINA, JIANGXI PROVINCE, Lushan Mountain, on dead branches of an unidentified broadleaf tree, 7 November 2014, J. Ma (HJAUP M0162).

COMMENTS – Delgado (2014) recorded this fungus on rachides of dead leaves from the palm species *Acoelorrhaphe wrightii* in Florida, USA, and compared it with similar species, including *Linkosia coccothrinacis*, *L. ponapensis* (Matsush.) R.F. Castañeda et al., *L. refugia* (B. Sutton & Pascoe) D.A.C. Almeida & Gusmão, and *L. canescens* (B. Sutton & Pascoe) D.A.C. Almeida & Gusmão. This is the first report of *L. longirostrata* in China. Our specimen is similar to the holotype from USA, but the holotype has smooth or slightly verrucose conidiogenous cells, and finely rough conidia without mucous tunicae at the apex (Delgado 2014); also, our specimen was collected from dicotyledenous wood, whereas the holotype was collected from monocotyledonous rachides.

Key to species of *Linkosia* from China

1. Conidia with 27–30 distosepta, 300–380 × 12–14 µm .... *L. multisepta*
1. Conidia with <21 distosepta and <210 µm long 2

2. Conidia 12–16 µm or 13–15 µm wide 3
2. Conidia <12 µm wide 4

3. Conidia with mucilaginous sheath at the apex, 100–160 × 13–15 µm .. *L. fusiformis*
3. Conidia lacking mucilaginous sheath, 122–177 × 12–16 µm .... *L. mori*

4. Conidia with 16–21 distosepta, 160–210 × 7.5–9.5 µm .... *L. hibisci*
4. Conidia <126 µm long 5

5. Conidia with 12–14 distosepta, 110–125 × 9–12 µm .... *L. obclavata*
5. Conidia with 10–18 distosepta, 82–126 × 6.5–8.5 µm .... *L. longirostrata*

Spadicoides klotzschii S. Hughes, Fungi Canadenses: no. 8, 1973. FIG. 2

CONIDIOPHORES macronematous, mononematous, unbranched, erect, straight or flexuous, cylindrical, smooth, brown to dark brown, 5–8-septate, 85–135 × 3.5–4.5 µm. CONIDIOGENOUS CELLS polytretic, integrated, terminal and intercalary, cylindrical, smooth, brown, 6–11.5 × 2.5–3.5 µm. CONIDIA acropleurogenous, solitary, dry, obovoid, smooth, brown to dark brown, basal cell paler, 2-euseptate, 10–11.5 µm long, 5–6 µm wide in the broadest part, 0.5–1 µm wide at the base.

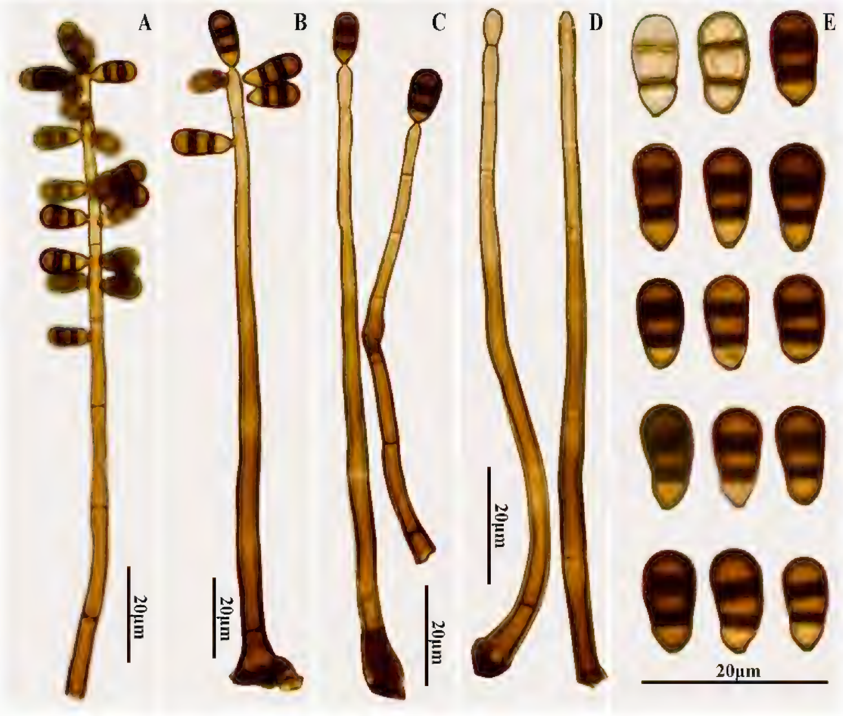

Fig. 2. *Spadicoides klotzschii* (HJAUP M0037). A–C. Conidiophores, conidiogenous cells and conidia; D. Conidiophores showing conidiogenous pores; E. Conidia. Scale bars = 20 μm.

> Specimen examined: **CHINA**, **Guizhou Province**, Leigongshan National Nature Reserve, on dead branches of an unidentified broadleaf tree, 7 September 2013, J. Ma (HJAUP M0037).

Comments – Hughes (1973), who reported *Spadicoides klotzschii* on dead wood of *Alnus* and from unidentified hosts in British Columbia, Canada, compared it with *S. obovata* (Cooke & Ellis) S. Hughes. Subsequently, Pinruan et al. (2007) recorded this fungus from Thailand. Compared with our specimen, the holotype has slightly narrower conidia (4–5.5 μm) and longer conidiophores (55–220 μm; Hughes 1973). This is the first report of *S. klotzschii* in China.

Spadicoides sylvatica Heredia, R.F. Castañeda & R.M. Arias,
Mycotaxon 130(2): 512, 2015. Fig. 3

Conidiophores macronematous, mononematous, unbranched, erect, straight or flexuous, cylindrical, determinate or occasionally percurrent,

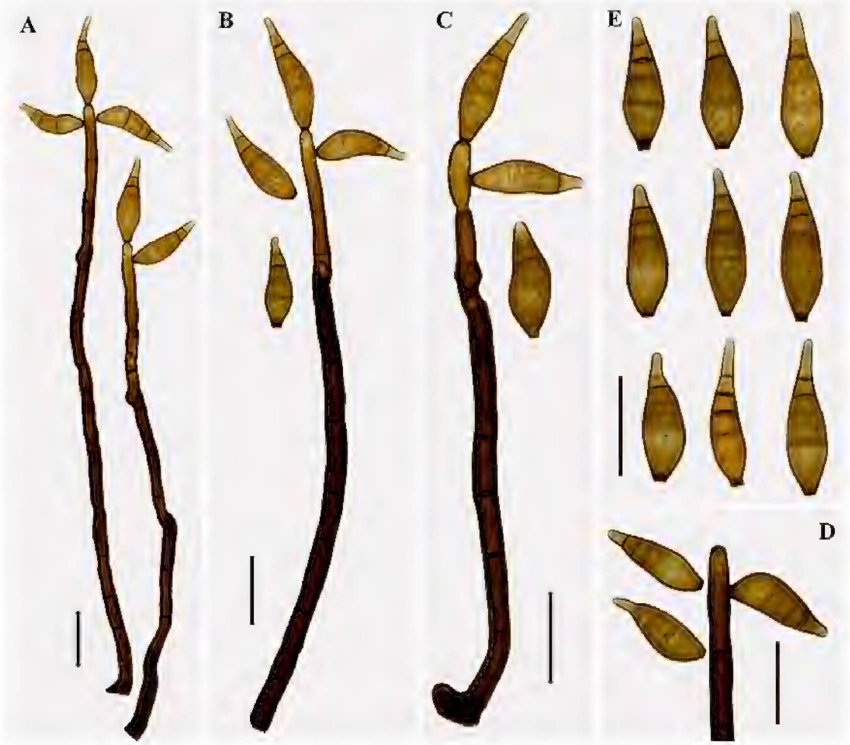

Fig. 3. *Spadicoides sylvatica* (HJAUP M0112). A–C. Conidiophores, conidiogenous cells and conidia; D. Conidiophore apex showing conidiogenous pores; E. Conidia. Scale bars = 20 µm.

smooth, dark brown, 6–13-septate, 130–220 × 4–7 µm. Conidiogenous cells polytretic, integrated, terminal and intercalary, cylindrical, smooth, brown, 14–25 × 3.5–5 µm. Conidia acropleurogenous, solitary, dry, ovate to obclavate, gradually tapered to an obtuse apex, smooth, brown, apical cell paler, (3–)4-euseptate, 25.5–35.5 × 6.5–9.5 µm, 1.5–2.5 µm wide at the base, 1.5–2.5 µm wide near apex.

Specimens examined: **CHINA**, **Guangdong Province**, Liuxihe National Forest Park, on dead branches of an unidentified broadleaf tree, 10 July 2014, J. Ma (HJAUP M0112, HJAUP M0116).

Comments – *Spadicoides sylvatica* was described from Mexico and compared with *S. yunnanensis* L.G. Ma & X.G. Zhang (Heredia et al. 2015); it has not previously been recorded from China. Our collection corresponds well with the original description of *S. sylvatica* except that the holotype has slightly smaller conidia (22–32 × 7–8 µm) with verruculose apical cells (Heredia et al. 2015).

Key to species of *Spadicoides* from China

1. Conidia non-septate 2
1. Conidia septate 4

2. Producing a synanamorph predominantly with 2-septate synconidia .. *S. wufengensis*
2. Lacking a synanamorph 3

3. Conidia smooth, 4–6.5 × 3–4 µm .... *S. atra*
3. Conidia verruculose, 11–18 × 4–6 µm .... *S. arengae*

4. Conidia with both eusepta and distosepta 5
4. Conidia with only eusepta 6

5. Conidia either 0–1-euseptate, or with 1 euseptum + 1 distoseptum,
   9–13 × 5–8 µm .... *S. hodgkissii*
5. Conidia with 2 eusepta + 1 distoseptum,
   13–14 × 5.5–6 µm .... *S. versiseptatis*

6. Conidia verruculose 7
6. Conidia smooth 8

7. Conidia 5–7-euseptate, 30–72.5 × 5–7.5 µm .... *S. bambusicola*
7. Conidia 9–12-euseptate, 98–166 × 8.5–12 µm .... *S. bawanglingensis*

8. Conidia versicolorous 9
8. Conidia concolorous 12

9. Conidia 3–4-euseptate, 25.5–35.5 × 6.5–9.5 µm .... *S. sylvatica*
9. Conidia predominantly 2-euseptate 10

10. Conidia 10–11.5 × 5–6 µm .... *S. klotzschii*
10. Conidia at least 12.5 × 6 µm 11

11. Conidia ovoid, 15–22 × 7–10 µm .... *S. camelliae*
11. Conidia obovate, clavate, 12.5–16 × 6–8.5 µm .... *S. obovata*

12. Conidia bacilliform, 3-euseptate, 33–55 × 5.5–6.5 µm .... *S. bacilliformis*
12. Conidia obclavate, oval to reniform or obpyriform to ovoid 3

13. Conidia 11–15-euseptate, 65–115 × 11.5–13 µm .... *S. multiseptata*
13. Conidia <8-euseptate and <65 µm long 14

14. Conidia 2–3-euseptate, <28 µm long, rounded or acute at the apex 15
14. Conidia at least 5-euseptate, 40–65 µm long, rostrate 16

15. Conidia oval to reniform, 16–23 × 6.5–8 µm .... *S. longchiensis*
15. Conidia obpyriform to ovoid, 18.5–28 × 6.5–10 µm .... *S. yunnanensis*

16. Conidia 6–8-euseptate, 40–65 × 4.5–5.5 µm .... *S. lushanensis*
16. Conidia 5(–6)-euseptate, 40–65 × 10.5–12.5 µm .... *S. rostrata*

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